We claim

1. A method for archiving nucleic acid, comprising:

a) contacting a sample containing said nucleic acid with a solid phase matrix under conditions that allow said nucleic acid to become tightly bound to said matrix, wherein said matrix is a specific binding material having one or more electropositive materials rendered hydrophilic, said electropositive material comprising elements selected from the group consisting of aluminum, titanium, zirconium, hafnium, scandium, yttrium, lanthanum, vanadium, tantalum, chromium, molybdenum, tungsten, boron, gallium, indium, germanium, tin, and lead; and

b) storing said tightly bound nucleic acid on said solid phase matrix.

2. The method of claim 1, wherein said matrix is selected from the group consisting of aluminum oxide, titanium oxide (Ti_2O_3), and modified zirconium dioxide (ZrO_2).

3. The method of claim 1, wherein said matrix is selected from the group consisting of alpha aluminum oxide, gamma aluminum oxide and an aluminum oxide thin-film of mixed composition.

4. The method of claim 1, wherein said matrix is Ti_2O_3.

5. The method of claim 1, wherein said matrix is modified ZrO_2.

6. The method of claim 1, wherein said nucleic acid is selected from the group consisting of double stranded DNA, single stranded DNA, RNA, or PNA.

7. The method of claim 1, wherein said nucleic acid is double stranded DNA, and step (a) further comprises adding a buffer that allows said DNA to be bound to said matrix as single stranded DNA.

8. The method of claim 5, wherein said buffer is selected from the group consisting of guanidine thiocyanate-based buffers, alkaline buffers, lithium chloride, and detergent based buffers.

9. The method of claim 1 wherein said sample contains both DNA and RNA, and step (a) is performed under conditions wherein said matrix exclusively binds said DNA.

10. The method of claim 9, wherein said conditions comprise adding to said sample a buffer selected from the group consisting of guanidine thiocyanate-based buffers, alkaline buffers, lithium chloride, and detergent based buffers prior to contacting said sample with said solid phase matrix.

11. The method of claim 9, wherein said conditions comprise adding to said solid phase matrix a buffer selected from the group consisting of guanidine thiocyanate-based buffers, alkaline buffers, lithium chloride, and detergent based buffers prior to contacting said sample with said solid phase matrix.

12. The method of claim 1, wherein said sample contains both DNA and RNA, and step (a) is performed under conditions wherein said matrix exclusively binds said RNA.

13. The method of claim 12, wherein said conditions comprise adding a DNA degrading reagent to said sample prior to contacting said sample with said solid phase matrix.

14. The method of claim 13, wherein said DNA degrading reagent is DNAse.

15. The method of claim 1, wherein said sample is selected from the group consisting of blood, stool, sputum, mucus, cervical fluid, vaginal fluid, cerebral spinal fluid, serum, urine, saliva, teardrop, biopsy samples, histological tissues, tissue culture products, bacterial cultures, swabs, agricultural products, environmental samples, waste water, drinking water, foodstuff, and air.

16. The method of claim 1, wherein said solid phase matrix is coated on the surface of a substrate.

17. The method of claim 15, wherein said substrate is a glass or polymeric material.

18. The method of claim 15, wherein said substrate is in the shape of tubes, plates, membranes, capillaries, slides, beads, microparticles, fibers, microchannels, and microarrays.

19. A method of amplifying one or more target nucleic acids, comprising:

a) contacting a sample containing said one or more target nucleic acids with a solid phase matrix and a buffer that allows said one or more target nucleic acid sequences to become tightly bound to said matrix as single-stranded target nucleic acid, wherein said matrix is a specific binding material having one or more electropositive materials rendered hydrophilic;

b) contacting said matrix-bound target nucleic acid with a set of primer nucleic acid sequences and a buffer that allows said primer sequences to hybridize to said matrix-bound target nucleic acid; and

c) amplifying said one or more target nucleic acid to produce an amplified reaction mixture, wherein said target nucleic acid sequence remains tightly bound to said matrix.

20. The method of claim 19, wherein said buffer in step (b) reduces binding of said primer set to said solid phase matrix

21. The method of claim 19, wherein said electropositive material comprises elements selected from the group consisting of aluminum, titanium, zirconium, hafnium, scandium, yttrium, lanthanum, vanadium, tantalum, chromium, molybdenum, tungsten, boron, gallium, indium, germanium, tin, and lead.

22. The method of claim 21, wherein said matrix is selected from the group consisting of aluminum oxide, titanium oxide (Ti_2O_3), and modified zirconium dioxide (ZrO_2).

23. The method of claim 19, wherein said matrix is selected from the group consisting of alpha aluminum oxide, gamma aluminum oxide and an aluminum oxide thin-film of mixed composition.

24. The method of claim 19, wherein said matrix is Ti_2O_3.

25. The method of claim 19, wherein said matrix is modified ZrO_2

26. The method of claim 19, wherein said buffer in step (a) is selected from the group consisting of guanidine thiocyanate-based buffers, alkaline buffers, lithium chloride, and detergent based buffers.

27. The method of claim 19, wherein said buffer in step (b) is a phosphate buffer.

28. The method of claim 19, wherein said target nucleic acid is selected from the group consisting of double stranded DNA, single stranded DNA, RNA, or PNA.

29. The method of claim 19, wherein said target nucleic acid is double stranded DNA and said buffer in step (a) allows said DNA to be bound to said matrix as single stranded DNA.

30. The method of claim 19, wherein said amplification methodology is selected from the group consisting of PCR, SDA, NASBA, IsoCR, CRCA, Q beta replicase, branched chain DNA, RT-PCR, and unwinding coil amplification.

31. The method of claim 19, further comprising repeating steps (b) and (c) one or more times.

32. The method of claim 19, wherein said sample comprises two or more target nucleic acids and said two or more target nucleic acids are amplified in series.

33. The method of claim 19, wherein said target nucleic acid contains multiple target nucleic acid sequences , said method further comprising contacting said matrix-bound target nucleic acid in step (b) with multiple primer sets to pre-amplify said multiple target sequences, wherein said multiple target sequences are amplified simultaneously.

34. The method of claim 33, further comprising:

(d) dividing said pre-amplified reaction mixture of step (c) into a plurality of aliquots; and

(e) adding at least one of said primer sets to each of said aliquots; and

(f) amplifying said aliquots.

35. The method of claim 19, wherein said solid phase matrix is coated on the surface of a substrate.

36. The method of claim 35, wherein said substrate is a glass or polymeric material.

37. The method of claim 35, wherein said substrate is in the shape of tubes, plates, membranes, capillaries, slides, beads, microparticles, fibers, microchannels, and microarrays.

38. A method of purifying a nucleic acid present in a sample containing non-nucleic acid contaminants, said method comprising:

a) contacting said sample with a solid phase matrix under conditions that allow said nucleic acid to become tightly bound to said matrix, wherein said matrix is a specific binding material having one or more electropositive materials rendered hydrophilic; and

b) washing said matrix-bound nucleic acid one or more times with a wash buffer to remove said non-nucleic acid contaminants, wherein said nucleic acid remains tightly bound to said matrix during said washing, thereby producing a purified nucleic acid tightly bound to said matrix.

39. The method of claim 38, wherein said electropositive material comprises elements selected from the group consisting of aluminum, titanium, zirconium, hafnium, scandium, yttrium, lanthanum, vanadium, tantalum, chromium, molybdenum, tungsten, boron, gallium, indium, germanium, tin, and lead.

40. The method of claim 38, wherein said matrix is selected from the group consisting of aluminum oxide, titanium oxide (Ti_2O_3), and modified zirconium dioxide (ZrO_2).

41. The method of claim 38, wherein said matrix is selected from the group consisting of alpha aluminum oxide, gamma aluminum oxide and an aluminum oxide thin-film of mixed composition.

42. The method of claim 38, wherein said solid phase matrix is titanium oxide (Ti_2O_3).

43. The method of claim 38, wherein said solid phase matrix is modified zirconium oxide (ZrO_2).

44. The method of claim 38, wherein said wash buffer is selected from the group consisting of water, 70% ethanol, polymerase chain reaction buffer, TRIS buffer, EDTA buffer, lithium chloride, and guanidium detergent based buffer.

45. The method of claim 38, further comprising:

(c) incubating said matrix-bound purified nucleic acid in a displacement buffer, wherein a small amount of said purified nucleic acid is displaced from said matrix into said displacement buffer; and

(d) amplifying one or more target nucleic acid sequences of said displaced purified nucleic acid.

46. The method of claim 45, wherein said displacement buffer is Tris/HCl buffer or water.

47. The method of claim 45, further comprising repeating steps (c) and (d) one or more times.

48. The method of claim 38, wherein said solid phase matrix is coated on the surface of a substrate.

49. The method of claim 48, wherein said substrate is a glass or polymeric material.

50. The method of claim 48, wherein said substrate is in the shape of tubes, plates, membranes, capillaries, slides, beads, microparticles, fibers, microchannels, and microarrays.

51. A method of concentrating nucleic acid contained in a sample, comprising:

a) providing a solid phase matrix, wherein said matrix is a specific binding material having one or more electropositive materials rendered hydrophilic; and

b) flowing said sample through or over said solid phase matrix, wherein said nucleic acid becomes tightly bound to said solid phase matrix.

52. The method of claim 51, wherein said electropositive material comprises elements selected from the group consisting of aluminum, titanium, zirconium, hafnium, scandium, yttrium, lanthanum, vanadium, tantalum, chromium, molybdenum, tungsten, boron, gallium, indium, germanium, tin, and lead.

53. The method of claim 51, wherein said matrix is selected from the group consisting of aluminum oxide, titanium oxide (Ti_2O_3), and modified zirconium dioxide (ZrO_2).

54. The method of claim 51, wherein said matrix is selected from the group consisting of alpha aluminum oxide, gamma aluminum oxide and an aluminum oxide thin-film of mixed composition.

55. The method of claim 51, wherein said solid phase matrix is titanium oxide (Ti_2O_3).

56. The method of claim 51, wherein said solid phase matrix is modified zirconium oxide (ZrO_2).

57. The method of claim 51, wherein said sample is flowed over said matrix at a rate between about 0.5 mL/min and 2 mL/min.

58. The method of claim 51, wherein said solid phase matrix is coated on the surface of a substrate.

59. The method of claim 58, wherein said substrate is a glass or polymeric material.

60. The method of claim 58, wherein said substrate is in the shape of tubes, plates, membranes, capillaries, slides, beads, microparticles, fibers, microchannels, and microarrays.

61. A method of capturing a target nucleic acid from a sample, comprising:

(a) contacting a probe comprising a nucleic acid sequence that is complementary to a specific sequence of said target nucleic acid with a solid phase matrix under conditions that allow said probe to become tightly bound to said matrix, wherein said matrix is a specific binding material having one or more electropositive materials rendered hydrophilic; and

(b) contacting said matrix-bound probe with said sample under conditions that allow said target nucleic acid to hybridize to said probe to form a complex, whereby said target nucleic acid is captured.

62. The method of claim 61, wherein said electropositive material comprises elements selected from the group consisting of aluminum, titanium, zirconium, hafnium, scandium, yttrium, lanthanum, vanadium, tantalum, chromium, molybdenum, tungsten, boron, gallium, indium, germanium, tin, and lead.

63. The method of claim 61, wherein said matrix is selected from the group consisting of aluminum oxide, titanium oxide (Ti_2O_3), and modified zirconium dioxide (ZrO_2).

64. The method of claim 61, wherein said matrix is selected from the group consisting of alpha aluminum oxide, gamma aluminum oxide and an aluminum oxide thin-film of mixed composition.

65. The method of claim 61, wherein said solid phase matrix is titanium oxide (Ti_2O_3).

66. The method of claim 61, wherein said solid phase matrix is modified zirconium oxide (ZrO_2).

67. The method of claim 61, further comprising dissociating said complex to remove said hybridized target nucleic acid, wherein said probe remains tightly bound to said matrix.

68. The method of claim 61, wherein said solid phase matrix is coated on the surface of a substrate.

69. The method of claim 68, wherein said substrate is a glass or polymeric material.

70. The method of claim 68, wherein said substrate is in the shape of tubes, plates, membranes, capillaries, slides, beads, microparticles, fibers, microchannels, and microarrays.

71. A method of coating a surface of a plastic material with a solid phase matrix, wherein said matrix is a specific binding material having one or more electropositive materials rendered hydrophilic, said method comprising:

a) heating said solid phase matrix to a temperature in the range of 700 to 800 degrees C;

b) cooling said plastic material to a temperature in the range of zero to 10 degrees C; and

c) contacting said heated solid phase matrix with said cooled plastic material, whereby said solid phase matrix coats a surface of said plastic material.

72. The method of claim 1F71 wherein said electropositive material comprises elements selected from the group consisting of aluminum, titanium, zirconium, hafnium, scandium, yttrium, lanthanum, vanadium, tantalum, chromium, molybdenum, tungsten, boron, gallium, indium, germanium, tin, and lead.

73. The method of claim 71 , wherein said matrix is selected from the group consisting of aluminum oxide, titanium oxide (Ti_2O_3), and modified zirconium dioxide (ZrO_2).

74. The method of claim 71 , wherein said matrix is selected from the group consisting of alpha aluminum oxide, gamma aluminum oxide and an aluminum oxide thin-film of mixed composition.

75. The method of claim 71 , wherein said solid phase matrix is titanium oxide (Ti_2O_3).

76. The method of claim 71 , wherein said solid phase matrix is modified zirconium oxide (ZrO_2).

77. The method of claim 71 , wherein said plastic material is in the shape of tubes, plates, membranes, beads, microparticles, fibers, microchannels, and microarrays.

78. A method of coating a surface of a plastic material with a solid phase matrix, wherein said matrix is a specific binding material having one or more electropositive materials rendered hydrophilic, said method comprising depositing a thin film of said matrix material on a surface of said plastic material.

79. The method of claim 78, wherein said electropositive material comprises elements selected from the group consisting of aluminum, titanium, zirconium, hafnium, scandium, yttrium, lanthanum, vanadium, tantalum, chromium, molybdenum, tungsten, boron, gallium, indium, germanium, tin, and lead.

80. The method of claim 78, wherein said matrix is selected from the group consisting of aluminum oxide, titanium oxide (Ti_2O_3), and modified zirconium dioxide (ZrO_2).

81. The method of claim 78, wherein said matrix is selected from the group consisting of alpha aluminum oxide, gamma aluminum oxide and an aluminum oxide thin-film of mixed composition.

82. The method of claim 78, wherein said solid phase matrix is titanium oxide (Ti_2O_3).

83. The method of claim 78, wherein said solid phase matrix is modified zirconium oxide (ZrO_2).

84. The method of claim 78, wherein said matrix is deposited by a method selected from the group consisting of plasma etching, chemical vapor deposition, and thermal evaporation.

85. The method of claim 78, wherein said plastic material is in the shape of tubes, plates, membranes, beads, microparticles, fibers, microchannels, and microarrays.

86. A method of coating a surface of a plastic material with a solid phase matrix, wherein said matrix is a specific binding material having one or more electropositive materials rendered hydrophilic, said method comprising:

(a) chemically activating the surface of said plastic material;

(b) providing a liquid precursor of said solid phase matrix; and

(c) contacting said chemically activated plastic surface with said liquid precursor.

87. The method of claim 86, wherein said electropositive material comprises elements selected from the group consisting of aluminum, titanium, zirconium, hafnium, scandium, yttrium, lanthanum, vanadium, tantalum, chromium, molybdenum, tungsten, boron, gallium, indium, germanium, tin, and lead.

88. The method of claim 86, wherein said matrix is selected from the group consisting of aluminum oxide, titanium oxide (Ti_2O_3), and modified zirconium dioxide (ZrO_2).

89. The method of claim 86, wherein said matrix is selected from the group consisting of alpha aluminum oxide, gamma aluminum oxide and an aluminum oxide thin-film of mixed composition.

90. The method of claim 86, wherein said solid phase matrix is titanium oxide (Ti_2O_3).

91. The method of claim 86, wherein said solid phase matrix is modified zirconium oxide (ZrO_2).

92. The method of claim 86, wherein said plastic surface is chemically modified by reactive plasma etching, strong acid treatment, or strong base treatment.

93. The method of claim 86, wherein said liquid precursor is aluminum s-butoxide

94. The method of claim 86, wherein said plastic material is in the shape of tubes, plates, membranes, beads, microparticles, fibers, microchannels, and microarrays.

95. A method of coating the surface of an oxide substrate with a solid phase matrix, wherein said matrix is a specific binding material having one or more electropositive materials rendered hydrophilic, said method comprising:

(a) combining said matrix with an acidic or a basic solution that promotes hydrolysis of said matrix;

(b) coating the surface of said oxide substrate with said mixture from step (a); and

(c) drying said coated surface.

96. The method of claim 96, wherein said electropositive material comprises elements selected from the group consisting of aluminum, titanium, zirconium, hafnium, scandium,

yttrium, lanthanum, vanadium, tantalum, chromium, molybdenum, tungsten, boron, gallium, indium, germanium, tin, and lead.

97. The method of claim 96, wherein said matrix is selected from the group consisting of aluminum oxide, titanium oxide (Ti_2O_3), and modified zirconium dioxide (ZrO_2).

98. The method of claim 96, wherein said matrix is selected from the group consisting of alpha aluminum oxide, gamma aluminum oxide and an aluminum oxide thin-film of mixed composition.

99. The method of claim 96, wherein said solid phase matrix is titanium oxide (Ti_2O_3).

100. The method of claim 96, wherein said solid phase matrix is modified zirconium oxide (ZrO_2).

101. The method of claim 96, wherein said oxide substrate is glass.

102. The method of claim 96, wherein said oxide substrate is in the form of capillaries, slides, beads, microparticles, fibers, microchannels, and microarrays.

103. A method of coating the surface of an oxide substrate with a solid phase matrix, wherein said matrix is a specific binding material having one or more electropositive materials rendered hydrophilic, said method comprising:

(a) mixing said solid phase matrix with a sol comprising a metal oxide precursor selected from the group consisting of tetramethoxysilane, tetraethoxysilane, titanium ethoxide, and aluminum s-butoxide;

(b) depositing said mixture from step (a) onto the surface of said oxide substrate;

(d) allowing said deposited mixture to gel on the surface of said oxide substrate; and

(e) allowing said gelled mixture to dry on said surface.

104. The method of claim 103, wherein said electropositive material comprises elements selected from the group consisting of aluminum, titanium, zirconium, hafnium, scandium, yttrium, lanthanum, vanadium, tantalum, chromium, molybdenum, tungsten, boron, gallium, indium, germanium, tin, and lead.

105. The method of claim 103, wherein said matrix is selected from the group consisting of aluminum oxide, titanium oxide (Ti_2O_3), and modified zirconium dioxide (ZrO_2).

106. The method of claim 103, wherein said matrix is selected from the group consisting of alpha aluminum oxide, gamma aluminum oxide and an aluminum oxide thin-film of mixed composition.

107. The method of claim 103, wherein said solid phase matrix is titanium oxide (Ti_2O_3).

108. The method of claim 103, wherein said solid phase matrix is modified zirconium oxide (ZrO_2).

109. The method of claim 103, wherein said oxide substrate is glass.

110. The method of claim 103, wherein said oxide substrate is in the form of capillaries, slides, beads, microparticles, fibers, microchannels, and microarrays.

111. A method of coating the surface of an oxide substrate with a solid phase matrix, wherein said matrix is a specific binding material having one or more electropositive materials rendered hydrophilic, said method comprising:

(a) subjecting a precursor of said solid phase matrix to conditions that promote hydrolysis of said precursor to form a solution phase reaction mixture;

(b) coating said substrate with said reaction mixture; and

(c) allowing said coated substrate to dry, thereby forming a thin metal oxide thin-film of mixed composition on said substrate.

112. The method of claim 111, wherein said electropositive material comprises elements selected from the group consisting of aluminum, titanium, zirconium, hafnium, scandium, yttrium, lanthanum, vanadium, tantalum, chromium, molybdenum, tungsten, boron, gallium, indium, germanium, tin, and lead.

113. The method of claim 111, wherein said matrix is selected from the group consisting of aluminum oxide, titanium oxide (Ti_2O_3), and modified zirconium dioxide (ZrO_2).

114. The method of claim 111, wherein said matrix is an aluminum oxide thin-film of mixed composition.

115. The method of claim 111, wherein said solid phase matrix is titanium oxide (Ti_2O_3).

116. The method of claim 111, wherein said solid phase matrix is modified zirconium oxide (ZrO_2).

117. The method of claim 111, wherein said oxide substrate is glass.

118. The method of claim 111, wherein said oxide substrate is in the form of capillaries, slides, beads, microparticles, fibers, microchannels, and microarrays.

119. A coated material prepared according to the method of claim 1F.

120. The material of claim 119, wherein said plastic is a substrate is in the shape of tubes, plates, membranes, capillaries, slides, beads, microparticles, fibers, microchannels, and microarrays.

121. The material of claim 119, wherein said coating is selected from the group consisting of alpha aluminum oxide, gamma aluminum oxide, an aluminum oxide thin-film of mixed composition, titanium oxide (Ti_2O_3) and modified zirconium dioxide (ZrO_2).

122. A coated material prepared according to the method of claim 1G.

123. The material of claim 1M122 wherein said plastic is a substrate is in the shape of tubes, plates, membranes, capillaries, slides, beads, microparticles, fibers, microchannels, and microarrays.

124. The material of claim 122, wherein said coating is selected from the group consisting of alpha aluminum oxide, gamma aluminum oxide, an aluminum oxide thin-film of mixed composition, titanium oxide (Ti_2O_3) and modified zirconium dioxide (ZrO_2).

125. A coated material prepared according to the method of claim 1H.

126. The material of claim 125, wherein said plastic is a substrate is in the shape of tubes, plates, membranes, capillaries, slides, beads, microparticles, fibers, microchannels, and microarrays.

127. The material of claim 125, wherein said coating is selected from the group consisting of alpha aluminum oxide, gamma aluminum oxide, an aluminum oxide thin-film of mixed composition, titanium oxide (Ti_2O_3) and modified zirconium dioxide (ZrO_2).

128. A coated material prepared according to the method of claim 1I.

129. The material of claim 128, wherein said plastic is a substrate is in the shape of tubes, plates, membranes, capillaries, slides, beads, microparticles, fibers, microchannels, and microarrays.

130. The material of claim 128, wherein said coating is selected from the group consisting of alpha aluminum oxide, gamma aluminum oxide, an aluminum oxide thin-film of mixed composition, titanium oxide (Ti_2O_3) and modified zirconium dioxide (ZrO_2).

131. A coated material prepared according to the method of claim 1K.

132. The material of claim 131, wherein said plastic is a substrate is in the shape of tubes, plates, membranes, capillaries, slides, beads, microparticles, fibers, microchannels, and microarrays.

133. The material of claim 131, wherein said coating is selected from the group consisting of alpha aluminum oxide, gamma aluminum oxide, an aluminum oxide thin-film of mixed composition, titanium oxide (Ti_2O_3) and modified zirconium dioxide (ZrO_2).

134. A kit for nucleic acid manipulation, comprising:

(a) a substrate having a surface coated with a solid phase matrix, wherein said matrix is a specific binding material having one or more electropositive materials rendered hydrophilic; and

(b) one or more containers comprising buffers or reagents necessary for manipulating said nucleic acid.

135. The kit of claim 134, wherein said substrate is in the shape of tubes, plates, membranes, capillaries, slides beads, microparticles, fibers, microchannels, and microarrays.

136. The kit of claim 134, wherein said substrate is a polymer or an oxide substrate.

137. The kit of claim 134, wherein said electropositive material comprises elements selected from the group consisting of aluminum, titanium, zirconium, hafnium, scandium, yttrium, lanthanum, vanadium, tantalum, chromium, molybdenum, tungsten, boron, gallium, indium, germanium, tin, and lead.

138. The kit of claim 134, wherein said matrix is selected from the group consisting of aluminum oxide, titanium oxide (Ti_2O_3), and modified zirconium dioxide (ZrO_2).

139. The kit of claim 134, wherein said matrix is selected from the group consisting of alpha aluminum oxide, gamma aluminum oxide and an aluminum oxide thin-film of mixed composition.

140. The kit of claim 134, wherein said solid phase matrix is titanium oxide (Ti_2O_3).

141. The kit of claim 134, wherein said solid phase matrix is modified zirconium oxide (ZrO_2).

142. The kit of claim 134, wherein said reagents include reagents for amplifying said nucleic acid.